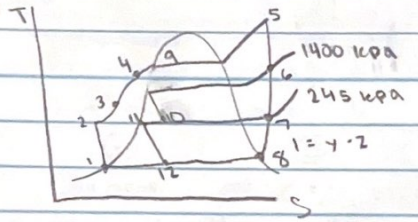
HW 2.2 - KAYLA DAVIES - MET350

10-57

a)



①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩
20 kPa	5000 kPa	1400 kPa	5000 kPa	5000 kPa	1400 kPa	245 kPa	20 kPa	5000 kPa	245 kPa

⑪	⑫
1400 kPa	20 kPa

$h_2 = h_1 + v_f(P_2 - P_1) = 251 + 0.00102(5000 - 20) = 256.08$ kJ/kg

b) $z = \dfrac{(h_3 - h_2) + y(h_{11} + h_{10})}{h_7 - h_{11}}$

$z = \dfrac{(533 - 256.08) + (0.1446)(533 - 630)}{2918 - 533}$

$\boxed{z = 0.0981}$

c) $\dot{m}_w = \dfrac{m_3[(1-y-z)h_8 + (y+z)h_{12} - h_1}{\text{COUDE}}$

$\dot{m}_w = \dfrac{75[(1 - 0.1446 - 0.0981)(2.477) + (0.1446 + 0.0981)(533 - 251)]}{4.18 \times 10}$

$\dot{m}_w = 3147.5$ kg/s

d) $w_T = h_3 - yh_6 - zh_7 - (1-y-z)h_8$

$w_T = 3900 - (0.1446 \times 3406) - (0.0981 \times 2918) - (1 - 0.1446 - 0.0981)(2477)$

$w_T = 1245.4$ kJ/kg

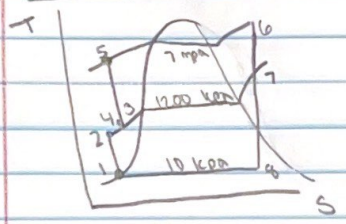
$\dot{W}_{net} = \dot{m} \cdot w_{net} = 75(1240.3) = \boxed{93.02 \text{ MW}}$

$Q_{in} = m(h_5 - h_4) = 75(3900 - 630) = 230.25$ MW

$\eta_{TH} = \dfrac{93.02}{230.25} = \boxed{40.4\%}$

HW 2.2

10-69



①	②	③	④	⑤	⑥	⑦	⑧
$P_1 = 10$ kpa	$P_2 = 1200$ kpa	$P_3 = 1200$	$h_4 = 344.4$	$P_5 = 4000$ kpa	$P_6 = 4000$ kpa	$P_7 = P_2$	$P_8 = 10$ kpa
$h_1 = h_f$	$h_2 = 193.0119$	$h_3 = 798.6$	$V_4 = V_1$	$h_5 = 347.2$	$T_6 = 600^\circ$	$S_7 = 7.09$	$h_8 = 2246$
$h_1 = 191.81$			$P_4 = 1200$ kpa		$h_6 = 3445.4$	$h_7 = 3079.7$	
$V_1 = 0.00101$						$m_7 = 13.75$	

$W_{pump_1} = V_1(P_2 - P_1) = 0.001010(1200 - 10) = 1.2019$ kJ/kg

$W_{pump_2} = V_4(P_3 - P_4) = 0.0010(4000 - 1200) = 2.8$ kJ/kg

$W_{turb} = m_7(h_6 - h_7) + m_7(h_6 - h_8) = 13.75(3445.4 - 3079.7) + (55 - 13.75)(3445.4 - 2246.6)$

$W_{turb} = 54303.63$ kW

$W_{pump} = m_1 W_{p1} + m_8 W_{p2} = (55 - 13.75) + 1.202 + 552.8)$

$W_{pump} = 203.6$ kW

$W_{net} = 54053.63 - 203.6 = \boxed{54300.1 \text{ kW}}$

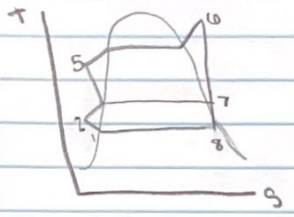
$Q_{in} = m_5(h_6 - h_5) = 55(3445.4 - 347.21) = 170400.7$ kW

$Q_{waste} = m_7(h_7 - h_3) = 13.75(3079.7 - 798.6) = 31365.125$ kW

$E_u = \dfrac{W_{net} + Q_{waste}}{Q_{in}}$

$= \dfrac{54300.1 - 31365.125}{170400.7} = 0.135 = \boxed{13.5\%}$

10-72



①	②	③	④	⑤	⑥	⑦	⑧
$P_1 = 10$ kPa	$P_2 = 1600$	$P_3 = 1600$	$P_4 = 400$	$P_5 = 9000$	$P_6 = 9$	$P_7 = 1600$	$s_8 = 6.26$
$h_1 = 191.8$		$h_3 = 858.44$	$h_4 = 858.44$		$h_6 = 3111.8$		$h_8 = 1990.2$
$v_1 = 0.00101$		$v_4 = 0.00116$			$s_6 = 6.28$		

$w_{pump_1} = v_1(P_2 - P_1) = 0.00101(1600 - 10) = 1.61$ kJ/kg

$h_2 = h_1 + w_{P_1} = 191.8 + 1.61 = 193.4$ kJ/kg

$w_{pump_2} = v_4(P_5 - P_4) = 0.001159(9000 - 400) = 8.57$ kJ/kg

$h_5 = h_4 + w_{P_2} = 858.4 + 8.57 = 867.02$ kJ/kg

$s_7 = x_7 = 0.9675$

$h_7 = h_f + x_7(h_{fg}) = 358.44 + 0.9675(1934.4) = 2730$ kJ/kg

$s_8 = x_8 = 0.7518$

$h_8 = h_f + x_8(h_{fg}) = 191.81 + 0.7518(2392.1) = 1990.2$ kJ/kg

$w_{turbine} = (h_6 - h_7) + (1 - \eta)(h_7 - h_8)$

$= (3118.8 - 2730) + (1 - 0.35)(2730 - 1990.2) = 869.7$ kJ/kg

$w_{pump} = (1 - 0.35)(1.61 + 8.57) = 9.62$ kJ/kg

$w_{net} = 869.7 - 9.62 = 860.1$

$\dot{m} = \frac{25000 \text{ kJ/s}}{860.1 \text{ kJ/s}} = \boxed{29.2 \text{ kg/s}}$